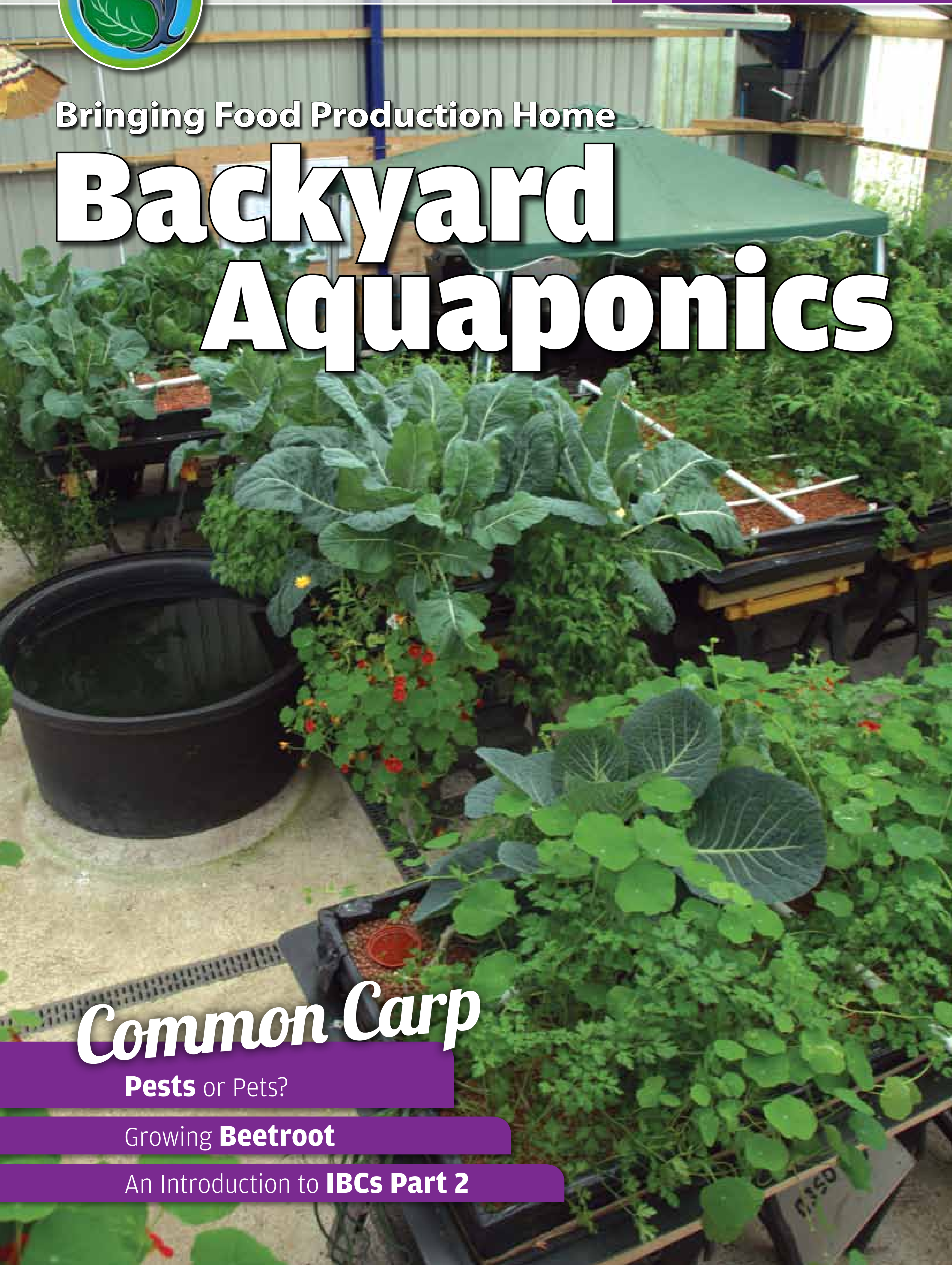
The No.1 Aquaponics magazine
for the backyard enthusiast.

Edition 12

Bringing Food Production Home

Backyard Aquaponics



Common Carp

Pests or Pets?

Growing **Beetroot**

An Introduction to **IBCs Part 2**

Welcome

Firstly, I just wanted to say, what a great cover picture we have in this edition. They are some of the aquaponic systems at Rowena and Philip's herb farm in Wales. The growth on some of their plants is just incredible, absolutely massive cauliflower and cabbage leaves as well as assorted healthy herbs of many different types.

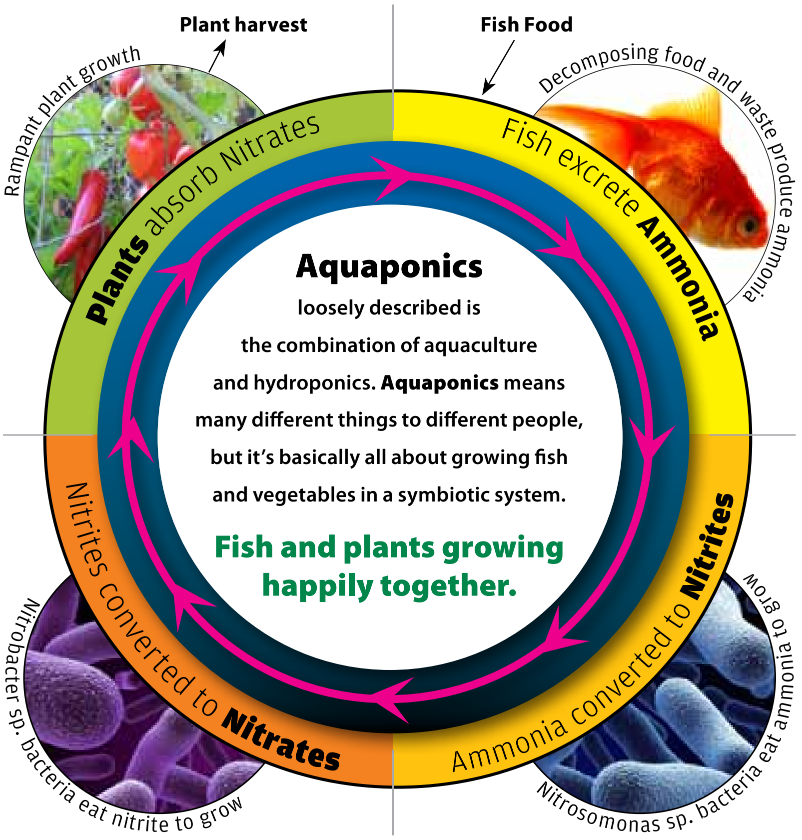
Nate gives us a rundown of retail trials with his ZipGrow towers. It's great to see aquaponics starting to appear in retail environments. Deb and Mike tell us a little more about their 10,000L pool conversion and how salt tolerance of plants plays an important role in their plant choices.

We have a look at common carp as a fish quite well suited to aquaponics, and Philip and Rowena tell us a little about their experiences growing them in their aquaponic systems in Wales. This edition also covers the second part of our article on IBCs, which includes a step-by-step guide to building an aquaponic system using an IBC. The other big news related to this is the release of our "IBC of Aquaponics" manual. It is over 180 pages of information about building aquaponic systems using IBCs as an essential ingredient. The manual is available as a free download through our main website and I can't recommend highly enough that you download this and have a read. There's a lot of general aquaponics information there and you can send it to all of your friends for free. Just one word of warning though, it is quite heavy in picture content, so quite a large download at about 38MB, still as I say, well worth it.

The other important news in this edition is that we've increased the page count from 36 pages up to 40 pages, and we've cut down on the number of adverts within the magazine. Magazine advertising in many publications is often between 50% and 75% of the total content. In previous editions, we had about 10% of advertising content, but in this edition there's just over 5% of advertising, so it's an even better value for everyone.

Joel Malcolm, Editor

The Nitrogen Cycle



Backyard Aquaponics on the tube

There are a whole range of aquaponics videos that you can view on youtube. Visit the link below and see us in action! New videos are added regularly. www.youtube.com/backyardaquaponics

Backyard Aquaponics

Backyard Aquaponics Magazine
is a quarterly publication which aims to promote the ideas of aquaponics and home food production, coupled with healthy and sustainable living.

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Front Cover
Rowena and Philip's amazing aquaponics setup in Wales

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Onwards and Upwards with aquaponics

An Experiment in Aquaponic Produce Sales

By Nate Storey

Back in Edition 10, I wrote about shifting growing planes to increase productivity. To do this, I used ZipGrow™ towers spaced in a way that allowed me to triple or quadruple the production of my system. In that article, I detailed some of the design variables that helped me develop the towers and the production method for using them. In this article, I'm going to do something similar, except I'm going to detail a tower design function that I didn't touch on then- live, local, in-store sales to consumers.

Nate has been researching Aquaponics for around six years now and with partner Paul Bennick, they have formed Bright Agrotech LLC which is a business supplying one store and several restaurants with quality aquaponic produce. Based in Wyoming, the desert climate is that of long, cold winters with fairly constant wind and very little rainfall- conditions that make greenhouse production a necessity. Nate has a bachelor's degree in Agroecology, a master's degree in Agronomy, and is currently finishing a doctorate at the University of Wyoming. Nate says, "We are working with several more grocery stores to supply high-dollar herbs, but because they are large corporate chains, it takes more time to get into them".

The traditional greenhouse production model has been one of centralization and economies of scale. Essentially, when it comes to producing lettuce in a greenhouse, businesses have ascribed to the "bigger is better" mentality, finding efficiencies and cost savings with increased size. Here in the United States, it means that many of these businesses have grown over the years, building large greenhouse complexes in centralized areas, or even outsourcing the business overseas to Central or South America. This is because, traditionally, labor has been one of the largest costs of production along with greenhouse heating and cooling costs. These companies found that the savings they received from centralizing their businesses in areas where labor and energy were inexpensive and regulation was low, more than made up for the increased costs of shipping their products hundreds, if not thousands, of miles. This business model was based on two assumptions: 1. Labor costs would stay low, and 2. Energy and shipping costs would remain low. Unfortunately for them, things have changed.

When I was in high school, I remember driving around town for hours, fueled by teenage hormonal imbalances and gas that cost (at its cheapest) $0.76 per gallon. Driving around, causing trouble, was the cheapest thing a couple of broke kids could do. Today, with some of the lowest prices in the world, I pay $3.79 per gallon, a 500% increase in cost over the last 15 years. This is a cost increase that is hitting centralized producers hard, forcing them to reduce their operational costs or raise the cost of their produce. The labor market has also changed. As the disparity in wages and standard of living between the developed, and the developing, world decreases, the gains from basing your company in a less developed area where labor is cheaper, slowly dwindle. Combine this with increased regulation and environmentally minded consumers, and the profit margins of the multi-national or centralized greenhouse grower become painfully tight. Enter the local producer.

While the large producer struggles, the local producers are emerging. In fact, here in the states, the local foods market has increased at roughly 14% per year for the last 10 years. This is an increase that I expect will accelerate as labor and energy costs rise, and the benefits of local production become known. So, the market is there and growing. Slowly, local producers are emerging, giving consumers the quality, pricing, and accountability they desire.

These local producers will be the champions of the next agricultural revolution, but there are still hurdles to making a good living producing for local markets. It was to address these hurdles that we developed our most recent piece of equipment for aquaponic produce sales: our patent pending ZipGrow™ display system. This display allows producers to

Cleaning up the towers

Choosing and rinsing the towers

eliminate much of the labor, harvest, and packaging costs inherent in traditional produce production by allowing ZipGrow towers to come out of the system whole, slide into the back of the truck, and be driven across town to the store where the display is housed. Once at market, towers slide into the display, replacing towers already harvested by consumers. The fresh towers stay at market, where they are irrigated and maintained by the display while consumers cut live produce from the display front, paying for produce by weight. For the producer, this means that costs are reduced, waste is reduced, and consumers get the highest quality produce possible. For the retailer, this means energy and refrigeration equipment costs are reduced. The equipment is designed to use multi-sensory engagement to connect with the consumer in a stimulating and positive way. Research shows that the more senses you engage, the more likely you are to make a sale, and we took that into mind in our display. Additionally, we used natural and sustainable materials assembled in a way that reassures customers that what we are doing is natural, safe, and sustainable. This was a major concern in the design considerations as many consumers can initially be wary of aquaponic and hydroponic produce, perceiving it as unnatural or artificial for lack of soil and the traditional trappings of field agriculture.

We've been running our trial for almost 2 months now, doing live sales at a local organic and natural food store, with interesting results. Consumer response to the system has been overwhelmingly positive, with the only complaint being our greenhouse's inability to keep up with demand. The cut-your-own model works very well, for the most part. There is some consumer education that must take place for the system to maximize efficiency. In our case, we had to put up signs and ask store personnel to instruct consumers on the correct way to remove heads of bok choi. Some customers would hack the top half of the plant off, leaving the bottom half of the head. This meant that on a 2 lb head we were losing 1 lb at $3.61/ lb wholesale. With minimal effort, the heads being lost to this practice were reduced from almost 50% to close to 20% in the first week.

We have generally found that consumers are willing to pay more for their vegetables when they are able to harvest their own. We theorize that this is because the act of harvesting functions as a sort of sensory value-added process, impacting the consumer perception regarding the quality of the produce. While the produce quality is superior to the typical produce on the shelves, consumer perception of its quality may be higher than can be accounted for only by its freshness. We believe that this is because it is also local, perceived as sustainable, and because there appears to be some level of accountability associated with the produce. All of the sales have been through word of mouth and through coming in contact with the display, and I have personally met many of the customers while stocking the display. It gives me a chance to explain aquaponics and exactly how the produce is grown. This gives customers what they really want from their food: transparency. The reality of the local foods movement is that people want to know that their food is safe and sustainable, and there's no better way to do that than to shake the grower's hand and hear it from the source. Right now we are in the process of expanding our greenhouse

Moving to the delivery car

Inserting towers into the display

Nate tending the display

Anne Marie is pictured here. She is a repeat customer who enjoys fresh produce

production and focusing more on herbs in preparation for an herbs trial. Charging by the ounce, our wholesale pricing is double to triple what most producers receive. When the price is adjusted for the amount of waste material (i.e. stems and woody portions of the plant) that customers choose to pick and pay for, this wholesale price is 4 to 6 times what most herb producers receive. The price of herbs is traditionally high due to processing and packaging costs, so to eliminate these costs while simultaneously charging consumers more for the product is very good for our margins. Because of this, we're initiating an herb trial that will look at this more in-depth and determine if there is a specialty market here, tailor made for ZipGrow aquaponic producers.

Another market that we are looking at is the direct sales of live produce to restaurants using our ZipGrow restaurant racks. These allow chefs to cut live produce from towers in much the same way that consumers pick from

To get commercial aquaponics into the mainstream, I think a few things need to happen:

1 Aquaponic producers need to develop their own market, apart from the traditional market of large hydroponic and field producers. If aquaponics practitioners try to compete in the same market and business model as traditional hydroponic producers, they will inevitably accept the same low margins that the industry currently operates in.

2 Aquaponic producers need to use equipment and innovation to access niche markets, reduce costs, and differentiate what they produce from the produce of the large, centralized companies. Given time, Aquaponic producers can change the nature of the demand for produce, and become competitive with large hydroponic producers if they are innovating and giving consumers a better product or experience than what is currently available to them. Innovation and improvement are essential to increasing your market share and reducing your costs.

3 Aquaponic producers need to appeal to the local foods movement and connect with their customers. At the root of every food movement is the consumer's desire for transparency. Establish trust and transparency with your consumers, and they will become repeat customers.

4 Aquaponic producers need to turn weaknesses into strengths. Small producers are uniquely situated to respond to local consumer demand, gain insight into local niche markets, and develop relationships with consumers in ways that are unattainable to large corporations. Input costs for aquaponics are higher, but offer powerful marketing opportunities for accessing sustainability, community, and environmentally oriented consumers.

the display, and increase the market size for local aquaponic producers- but more on that next time.

This has been a long process for me- developing the towers and the display equipment, (and soon another production and sales tool for producers that I won't talk about quite yet) but it's motivated by the realization that commercial, community-oriented aquaponics is feasible and attainable.

Our equipment was designed to help producers accomplish these objectives, and it's been very exciting designing and implementing it. We feel that this display is a powerful improvement over traditional produce sales and so far, our income supports our theory. This is a time of flux for food. Oil prices are rising, food prices are fluctuating, and consumers are developing strong opinions regarding food production that are generating entirely new markets. For many people, it's easy to become cynical about the future of food, aquaponics and sustainable agriculture, but it's times like these that flip convention on its head and allow entire industries to be born. I think that commercial aquaponics is one of these industries, and I and the staff here at Bright Agrotech, as well as our customers, producers, and aquaponic friends, are all excited and proud to be a part of this movement.


Moving towers to market

> "We have found that consumers are willing to pay more for their vegetables when they are able to harvest their own."

salt tolerant PLANTS

By Deb McCarthy

Deb & Mike began growing fish in their 10,000 litre swimming pool in 2008. They have been harvesting trout and barramundi ever since. Deb shares with us their success in growing in salt water.

Even though fish like trout and barramundi are able to live in fresh water, a certain amount of salt is good for their health. This is because they actually have an internal salt concentration, and if this is higher than the water they live in, the effect of osmosis (water moving from a higher salt level to a lower one) means that water will transfer from the body of the fish to the pond or tank. Adding salt to the pond water reduces this transfer and so the fish save energy-making them more able to fight off disease and injuries. This is even more important if the fish are stressed, either from poor handling or poor conditions.

In aquaponics, the benefits of salt are known, but there is always that balance of adding salt for fish health, and keeping it at a minimum for best plant growth. There are regular posts on the forum where members' concerns for their plants delay their decision to add salt to the tank. As a result, their fish show signs of stress or disease leading to possible death.

Some plants certainly do not tolerate salt, but a surprising amount do, and often to quite high levels and over

“In aquaponics, the benefits of salt are known, but there is always that balance of adding salt for fish health, and keeping it at a minimum for best plant growth.”

a long period of time. We have not experimented with the effects on plants for short periods such as when salt may be suddenly needed for the fish in an aquaponics system, and then possibly diluted again. Our system is more aquaculture-based, so our focus on fish health means we keep our fish in water salted to 5ppt. We do, however, grow edible plants in floating rafts (as in the Deep Water Culture method) and have experimented to see which plants will survive at this level.

Silverbeet can take on a salty flavour

Celery does very well growing in net pots floating on the water surface

Suprisingly, quite a few do! Some plants, such as silver beet, seem to take up some of the salt, and even when washed, have a slight salty taste. The leaves also tend to be slightly brittle compared with that grown in the garden.

We have also successfully grown basil, beetroot (the leaves grew well but not the beet itself), and broccoli (the heads grew well but not the leaves, which really doesn't matter!) Brown mignionette lettuce grows fine too, but other types of lettuce don't seem to cope with 5ppt, though may be fine with the 2-3ppt that most aquaponic systems would experience.

Other plants that seem to grow successfully are Lebanese cress/ Croation lettuce, gotu kola, and celery. Unlike spinach and silver beet, the celery doesn't seem to absorb the salt, but it certainly grows well. In fact, it has grown better than those planted in the garden at the same time.

Polystyrene rafts are easy to make and are a great way to control spreading plants like watercress

We haven't had much success with mizuna, parsley, tomato, or chives, and obviously, there are lots more plants out there that we haven't tried yet.

Our experiments, so far, show that some plants are grown very successfully in water with a relatively high salt content, and over an extended period of time. If fish are showing signs of stress or disease, adding salt can have huge benefits to their health and even their very survival. Most of the time, a salt content of 3ppt will be sufficient for this, so it is quite likely that most plants will survive this level, especially if it is for a short period. Yes, some plants may suffer, but many won't, and if the fish die, then the whole system is jeapordised anyway and all could be lost!

As it says on the BYAP website, "fish are the powerhouse of an aquaponic system". Happy, healthy fish are essential for healthy plant growth, otherwise, what is the point?

Basil grows well in lettuce cups suspended on a floating raft

Floating plants on the water surface are another way to utilise the growing area- either in a floating basket or simple raft

Growing Beetroot

Beetroot belongs to the amaranth family and is probably the most widely cultivated form of beet in Europe and North America. It is most commonly grown for its succulent red tuber. The beetroot plant grows to a height of about 60cm (2ft) and has large, shiny leaves.

By John Lawrence

Beetroot thriving in the BYAP growbed

There are two main varieties: round beetroots and long beetroots. Round types have globular roots and the roots of the long variety look very similar to that of parsnips. Long varieties normally take longer to mature than round ones and they tend to be bigger – up to 25cm in length.

History and current cultivation

The grandfather of the modern beetroot grown in our gardens is the sea beet, which flourished along the Mediterranean coast in ancient times. Remains of beetroot have been unearthed by archaeologists in the pyramid of Saqqara in Egypt, which dates back to the Third Dynasty.

In Aartswoud, in the Netherlands, another team of archaeologists have recently discovered remains of beetroot dating back to the Neolithic Period! It is, however, difficult to ascertain whether these remains were wild or domesticated varieties of beetroot.

The earliest written reference to beetroot was found in Mesopotamia, in writings dating back to the eighth century B.C. It was also referred to by Aristotle. Jewish and Roman sources indicate that by the first century B.C, the leafy versions of beetroot were cultivated widely in the Mediterranean basin. Moving on a few hundred years, various sources indicate that beetroot was also widely cultivated in Europe

There are multiple varieties of beets available such as orange, red, and even a candy stripe, called chioga

Modern varieties of sugar beet can be traced back to the 1700s when the King of Prussia provided funds for experiments to extract sugar from beetroot. A certain Andreas Marggraf discovered that beetroot contains up to 1.6% sugar, and that sugar, similar to that extracted from sugar cane, could be extracted from beetroot. The first factory to extract sugar from sugar beets was built in Silesia, which is part of modern-day Poland, during 1801.

The experiments in Silesia caught the attention of the Europeans, specifically the French. Napoleon even started a number of schools dedicated to the study of beetroot! He also issued an order that an experimental beetroot farm be established and set aside 28,000 hectares for that purpose. His actions were motivated by the fact that the British imposed a blockade on cane sugar during the Napoleonic Wars.

By 1880, more than 50% of world sugar production came from sugar beets. The first recorded cultivation of sugar beet in the USA was in California during 1879. German settlers also introduced the crop to Chile. Modern day varieties of sugar beet have a much higher sugar content than those tested by Marggraf in the 18th century.

Nutritional value and health benefits

Beetroot is an ample source of betaine which, in turn, is beneficial to cardiovascular health. Betaine has been shown to work with other nutrients in the prevention of heart disease, vascular diseases, and strokes. Several studies done on both humans and rats also found that betaine can help to prevent the accumulation of fatty deposits in the liver. It is also prescribed in cases where a person has too little natural stomach acids.

It has to be mentioned that the sugar found in beetroot is much easier for the body to absorb than that found in cane sugar. Sugar found in cane sugar must first be converted into fruit sugar by the body, while the sugar found in beetroot is already in a form which can be easily absorbed by the body.

Uses

Beetroot is very popular as a root vegetable. The roots are cooked and either eaten as a boiled vegetable, or served cold in salads with vinegar and oil. Raw, shredded beetroot is often used in salads, either on its own or mixed with other salad vegetables.

A considerable amount of beetroot is grown yearly to be processed or used in the production of pickled beets. In many Eastern European countries, beetroot is also popular for making beet soup, for example, the delicious cold borscht, or cold beet soup, one finds in Northern Europe and some Slavic countries.The leaves of the beetroot plant are, in fact, edible, and many people boil or steam it and use it as a substitute for spinach, since the taste and texture are quite similar. Recently, loose leaf greens and salad leaves have become available in grocery stores and markets. So, while you are waiting for the root to form, why not try a variety of leaves in a salad?

Last but not least,significant amounts of alcohol can be distilled from beetroot and it can also be used to produce a pleasant, sweet-tasting wine. Mangolds can also be used to brew an excellent domestic beer! That should be good news for those of us who previously thought that Mangold was only good for animal fodder.

Where to grow

Many people mistakenly believe that you cannot grow root vegetables in an aquaponic system. Beetroot actually grows very easily as it sends the root down to extract nutrients and pushes the bulb above the media, growing a clean plant.

When to plant

Although it is possible to start sowing beetroot in late winter, you will have more success if you sow them later, after all danger of frost has passed. Early to mid-spring is a better option. Refer to the planting guide in the back of this magazine.

Caring for the plants

Beetroots are really easy to care for. As long as you keep the area around the plants weed-free and give them enough water, you should not have any problems. Regularly check the area around the stems to be sure that the soil below the surface doesn't become dry. Of course, this is not an issue in an aquaponic system.

Harvest

Beetroots should be ready for harvesting after about 3 months. Depending on which variety you have sown, the roots should be somewhere between the size of a golf ball and a tennis ball at that stage. Afterwards, remove the tops, but don't throw them away – they are very tasty and nutritious, and can be prepared in much the same way as spinach leaves.

It makes sense to harvest some and allow more free space for the remaining roots and give them the opportunity to grow bigger.

Storing

They can be stored in a cool, dry place, for example, a wooden box that you have filled with sand. If you want to store them for longer periods of time, it's best to pickle them or turn them in to a tasty relish. Beetroot leaves should be eaten fresh.

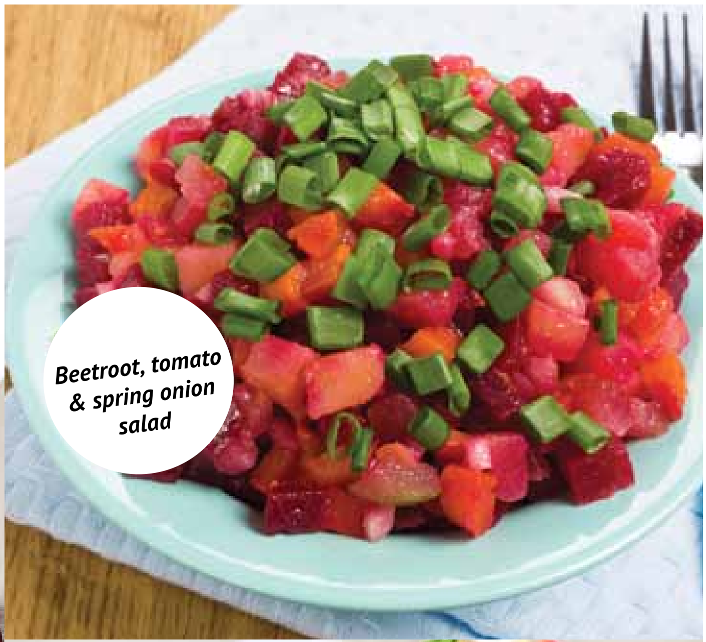
Preparation & Planting

Plants may be grown directly from seed or planted as seedlings. The cork-like seeds will germinate at a much quicker rate if soaked in warm water for about an hour or two, and then planted at a depth of 1-2cm. Some gardeners would suggest that if you are starting with seedlings from a punnet purchased from a commercial grower, that you can separate the seedlings to allow the root to develop without competition. However, we have found that they find their own space as they grow and it reduces the transplant shock by keeping them all together.

> “the sugar found in beetroot is much easier for the body to absorb than that found in cane sugar”

beetroot
dishes you can make
from your own aquaponic system

Baked fish with beetroot sauce

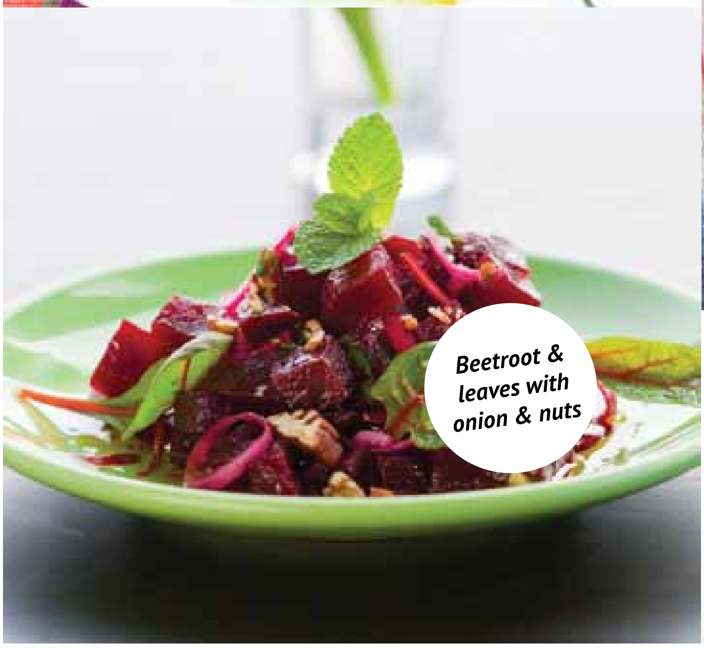


Beetroot, tomato & spring onion salad

Golden & red beetroot salad with parsley & feta

Beetroot, avocado & pinenut stack

Faye's Homemade burger with beetroot relish



Beetroot & leaves with onion & nuts

Roasted beetroots with chick peas and arugula

Common Carp

By Charmaine Webster

Carp is one of the most widely cultured fish in the world. It is one of the most commonly cultured ornamental fish, out of the hundreds of ornamental fish species there are. However, those that are cultured represent a few of the carp species that have farming significance, out of a thousand available.

The common carp, Chinese carp and Indian carp, are the species that have caught the attention of aquaculturists and hobbyists. Interestingly, it is related to the common goldfish with which it is capable of interbreeding.

Distribution

This species (Cyprinus carpio) in the family Cyprinidae, is a freshwater fish that lives in large bodies of water and lakes and large river systems. It is found in Europe and Asia historically, and has extended its range to the Black Sea, Caspian Sea, and Aral Sea.

Those that are in the wild are considered vulnerable to extinction. Those that have been domesticated and introduced into river systems worldwide are considered an invasive species.

It has been introduced (sometimes illegally), to most continents and is found in fifty-nine countries thus far.

History

It is native to Asia and can be found everywhere except the Middle East and the Poles. The common carp was first spotted in the inland delta of the Danube River some two thousand years ago. Then, it was torpedo-shaped and yellow in colour. It had two pairs of feelers and a mesh-like pattern for scales.

The Romans kept them captive in large, specially-built ponds in south-central Europe. The Asian and the European subspecies have been successfully domesticated as well, but Korea, Japan, and China already had this method perfected as far back as ca. 300B.C. – 300A.D.

Monks helped spread the fish between the thirteenth and sixteenth centuries mainly as food fish. The wild form of the fish reached the Rhine delta as far back as the twelfth century, probably with the aid of humans, as well.

Some variants have arisen due to domestication. These include the mirror carp that have large mirror-like scales. This fish is said to originate in Germany. Then there is the leather carp, which is virtually unscaled, except near its dorsal fin. The last is the fully scaled carp. Koi carp is mainly used for ornamental purposes today and originated in Japan in the 1820s.

Carp is still cultivated through monasteries in Europe today.

Biology

Although some people mistake carp for goldfish and vice versa, you can easily identify a carp by a single whisker at each corner of its mouth. They have a single dorsal, which has strongly serrated spines. Their scales are large

and thick. They have small eyes, thick lips, and a forked tail.

In the wild, they are usually olive green to bronze, or even silvery in colour with usually, a paler hue underside. Of course, the Japanese Koi have much more variety in colour from white, black, yellow, red, blue, and orange markings. However, all these strains belong to the same species- Cyprinus carpio.

They grow very large and can even reach lengths of over one metre and weighing a whopping sixty kilograms. The most common weights, however, are around four to five kilos.

This fish lays eggs. A healthy female adult can produce three hundred thousand eggs in a single spawning. They spawn in spring in response to rising water temperatures and rainfall. They can spawn multiple times in a season. In commercial settings, spawning is often stimulated using a process where lyophilized pituitary extract is injected into the fish. This hormone will stimulate gonad maturation and sex steroid production, which ultimately promotes reproduction.

In the wild, you will find that the common carp is much slimmer than what its domesticated counterpart is. It usually grows to a maximum of 120 centimetres and a maximum weight of forty kilograms. The oldest recorded age was sixty-five years.

Diet

The common carp is omnivorous. In the wild, they feed on water plants, but do scavenge mainly at the bottom for crustaceans, insects (including zooplankton), and worms. They are industrious when it comes to foraging and often grub through sediments for food. They are notorious for altering their feeding environment and can destroy and uproot submerged vegetation. This causes serious damage to native duck and fish populations. In captivity, they will readily feed on foods such as bloodworm, daphnia, worms, maggots, water insects, etc. You can also feed them with any good Koi food and scraps of vegetables, especially corn and peas.

Breeding

Carp will happily live with other native species of fish, provided they are not predatory. They are a schooling species, meaning they group together and cannot be kept in isolation. They are happy in a small group of 4-5. They will also thrive best when their environment is realistic. They need mud and pond plants such as weed and lilies. They also need to be stimulated somewhat, because they can become bored easily. Adding a few interesting things to the pond often will prevent boredom.

Males will develop breeding tubercles

Carp is a pest in waterways across the world

(whitish pimples) on the gill covers and on the leading edge of the pectoral fins. Females develop a deeper body as they fill with eggs, and have a larger vent.

It could be hard to get carp to spawn in an aquarium scenario because they need a definite winter and spring to develop the eggs. This condition will tell them when to spawn as well.

If you want to raise your own fingerlings however, for whatever reason, you would need to do the following:

You would need two separate ponds, a spawning one, and a nursery. The first pond will be used solely for when the fish mate and lay eggs. This pond is also where the fry will hatch.

Your spawning pond should be dug into the soil that can hold water. Dig about 2m x 3m in size and about 1m deep. Let the sun bake the soil completely dry. Once the surface has cracked, let fresh water into the pond about 50cm deep. Your pond is now ready for breeding stock. Place a mat of pondweeds such as water hyacinth to cover no more than a quarter of the water area. This will encourage spawning as eggs are laid among the roots. Choose healthy adults that are ready to spawn. Females will have swollen soft bellies and the males will secrete a white milky substance when gently squeezed. You need about ten of each.

Once they have spawned, which usually only takes one day, take them out and place them back into their own pond. The eggs will hatch in about two days. In a few days, the fry will be about 0.5cm long, and thin. Once they measure about 1cm long, they will need to go into their nursery pond. Handle them with care as they perish easily. Choose a soft, loosely woven cloth to catch them.

The nursery pond is a bit shallower than the spawning pond, but is prepared the same way. Once the soil is dry and baked well in the sun, sprinkle well rotted manure or compost and slowly fill the pond. This pond must have an inlet and an outlet for water to circulate. Put a fine mesh over the pipes to keep predators out and the fry in.

The fry can be fed first with some powdered egg yolk, and later, finely powdered oil cake (heat-treated) and rice bran. They will also nibble on small plants and insects that live in the water, so add some aquatic plants in the pond as well. They will reach finger size in about six to eight weeks. They are now ready to be placed into your fishponds, you can sell them to other farmers, or you can start your aquaponics system.

Husbandry and health

This fish prefers large bodies of water with vegetative sediments. They occur naturally in temperate climates in slightly brackish water or fresh water. The pH balance should be 6.5-9.0 and salinity up to 5%, and with water temperatures ranging between 3-35°C. The ideal temperature, however, is 23-30°C. They spawn at about 17-18°C.

They are also able to tolerate water with very low oxygen levels by gulping air at the surface.

A single carp can lay over a million eggs in one year. However, the eggs and young perish in similar numbers. The eggs and fry can sometimes fall victim to bacteria, fungi, and other predators in a pond environment.

They should, ideally, be transferred into a nursery while they are still in their egg sacks. This is possible by using tree branches or fibre mats to scrape the surface of the water once the eggs are released. They become fingerlings

Carp Subspecies

Cyprinus carpio carpio (European carp). Eastern Europe (notably the Danube and Volga Rivers).

Cyprinus carpio haematopterus (Amur carp). Eastern Asia.

Cyprinus carpio rubrofuscus. Southeastern Asia. Treated as a separate species Cyprinus rubrofuscus by many authorities.

Potential for Aquaponics

Although carp need a lot of space in which to live, they can be used in aquaponic systems successfully, provided you have a large tank/pond in which to keep them. Because aquatic plants grow rapidly in recirculating systems, you are able to grow many types of vegetation for the table in this symbiotic state.

People who use carp in their AP systems say that their tanks stay wonderfully clean. Because these fish get easily bored, they often lick the sides and bottom of the tanks clean for hours on end.

Another myth is that they are "very boney" on the plate. The truth is that they are great tasting when they live in an AP system because their diet is controlled, the water is clean, and they grow larger as well. Their notorious muddy taste is, therefore, lost because of the clean environment they live in.

Many AP owners are losing out on a great tasting fish, which is really not that boney compared to other fish.

They have, however, acquired a rather nasty rap during the years because of their tough nature and their ability to readily adapt in many areas of the world. Many countries see them as noxious pests and, as such, are not easily obtainable. There are often high fines for keeping them, so it is best you find out at your local authority if you are allowed to keep them.

They can reach lengths of more than 1 metre and weigh up to sixty kilos

> "Carp are great tasting when they live in an AP system because their diet is controlled and the water is clean"

after a month and can be transferred to grow-out ponds after two months.

To cultivate your own carp, you would need a shed for protecting cultures, tanks and ponds for breeding and rearing, and for holding the brood stock and larvae. You will also need a pump for lifting or moving water. A good water supply network is essential as well as electricity, air blower, heater, and aquarium and laboratory instruments to test cultures. Then there are various feeds and plants to consider as well.

Cyprinus carpio is the number one fish of aquaculture. Roughly three million tonnes are produced annually. China is the largest producer, accounting for 70% of carp production worldwide. It is commonly cultured as a sport fish in Western Europe, and there are small markets that sell them as food fish. It is commonly used as a Christmas Eve dinner in many European countries, as well.

You should always remember the following aspects when choosing a fish to incorporate into you aquaponic system:

In an ideal world they should be capable of reproducing in captivity, produce numerous and hardy eggs and young, and have well known culture requirements. They should be easily adaptable to tank or pond scenario and should, ideally, be able to adapt to a polyculture (multi-species) environment. They should also exhibit rapid growth to a large, maximum size.

A very important aspect is that they should be able to handle artificial feeds, and be able to tolerate crowding and high-density conditions. Ideally, they should also have a low mortality rate, should be easy to transport, and easy to harvest. You do not want cannibalistic or territorial species, as they will wipe you out within weeks.

Your fish should also have a high feed conversion rate. Lastly, they should have good eating qualities if you are going to cultivate them for the plate.

Rowena and Philip`s **common carp experiences** in Wales

By Rowena and Philip Mansfield

We have two large fish tanks (4500 litres) on a CHIFTPIST system. One fish tank has one long growbed growing just water cress.

The other fish tank supports three growbeds growing mint, thyme (common and caraway), chives, winter purslane, and a couple of strawberry plants.

We have common and mirror carp along with a couple of goldfish in both tanks. When we were first debating going into aquaponics, we consulted a well respected local aquaculture expert on the best fish to keep in tanks in our local environment.

"If you have access to free, heated water all the year round, then keep tilapia." "Can you sell them locally?" The answer, after speaking to local outlets, was "Very few".

We were told, "keep trout as you do not have to heat your water and they will sell well. They will need a bit more attention than other fish, but will be worth it."

"What about common carp?"
"Excellent fish, will tolerate an environment that would probably see off your trout, in fact, you have a job to kill the blighters."

First-class bit of advice and we have been very pleased with the carp. They are much slower growing than trout but will grow much bigger over time. Also, carp are not as finicky as trout.

Can we sell them? There is a very big demand for carp within the East European communities in the UK so, anyone thinking of developing carp rearing will have access to a ready market.

One thing we have found when buying in, young carp is to put them in an isolation tank - well salted, for a period of a few days, as fungal infections may take that long to manifest themselves. We had a problem where one whole batch was infected and had to be disposed of before it could infect everything else. The tanks then had to be disinfected as well.

Other than that, we are very pleased with the carp and would recommend growing them to both novice and experienced APers!

Learning about carp and aquaponics

Growth from the carp tank

Philip and Rowena in front of their system

Philip checking on the duckweed

Nice little carp

Two spotted MITE

also known as the Red Spider Mite

By Faye Arcaro

These bugs can be a little hard to identify as they are hard to see, and it is often the tell tale signs they leave behind that allow us to identify this common microscopic pest. This mite is so small that it is barely visible to the naked eye and you would need a magnifying glass to accurately identify it. Confusion reigns when it is known by a variety of different names. This pest is also known as a two-spotted mite and is not always red and does not always have eight legs. Aaah, we will explain as the article moves on.

The first signs may be that of a silvery looking leaf where the sap has been rasped, a term that refers to the damage caused by the mouthparts of this tiny insect. You may see tiny droppings caught in a fine web. If you continue to monitor the damage over a period of a week or so, you may witness the explosion of webbing as well as grouping of hundreds of tiny insects. The host plant will literally be sucked dry by them if they are in large numbers. They leave tiny pale spots or scars where the epidermal cells of a plant have been destroyed. An individual lesion is small. The frequently observed attack of thousands of spider mites can, however, cause thousands of lesions on the plant which will significantly reduce the photosynthetic capability of the plants. This, in turn, will greatly reduce their production of nutrients which will almost always cause their death. The underside of the leaf will also give you a clue as the young will eat away at the leaf, sucking the life out of the plant. This will sometimes leave clues on top of leaves as well. Look out for silvery or yellowish cluster spots, the size of a full stop. They will also give themselves away only if they are clustered, so look out for small knobs or humps on the leaves as well.

The spider mite likes most vegetables and other food crops including strawberries, corn, peppers, potatoes, beans, tomatoes, and ornamentals such as roses. It is easily identified by its finely spun webs underneath the leaves, and is a common pest in greenhouses and thrives in dry environments. They can lay millions of eggs all over the leaves and can quickly infest a crop due to the vast amount of eggs that hatch during optimum conditions. Spread can occur as the mites hitchhike on carriers such as bees and wasps, which we tend to encourage in our systems as they provide many benefits. If you have a greenhouse, you can prevent intrusion by using a bug screen, but then you will have to deal with issues in regard to pollination, so freely performed by the bees.

Two-spotted mites and eggs, with juvenile top right

Lifecycle

Temperature plays a key role in the proliferation of these insect pests, along with a dry and dusty environment. It is generally around springtime that the breeding season begins. If conditions are favourable, they will go until autumn and slow down with the onset of winter when they hibernate around the root zone, in wood or brickwork of buildings. The females that remain will now turn red as they overwinter. When spring approaches once again, they will re-emerge with their bright orange to red colouring to mate and lay eggs.

Their reproduction cycle can be so short that adults can lay eggs from only 36 hours old. The clusters of eggs are laid on the underside of the leaves close to the veins. It has been estimated that in perfect 26 degree celsius temperatures, the female adult represents a potential 13,000,000 individuals in a one-month period.

Biology

The most widely known member of the spider mite family is Tetranychus urticae, which is also commonly known as the two-spotted mite. It will start off and live most of its life with a greenish-brown appearance with two darker spots on its shoulders. As the weather changes to winter, it gains a strong red to orange colour. Another oddity about this mite is that it has 6 or 8 legs depending on the stage of development. Juvenile mites start with 6 legs and grow two more as they become adults, at which time it becomes spider-like, hence the other common name of red spider mites.

Infestation of mites clustered together at the tip of an eggplant leaf. Obvious signs include the presence of webbing

Two-spotted mites, juveniles and eggs, with an orange predatory persimilis which feeds on them

Image courtesy of Denis Crawford

Control Methods

If you can get to know your pest and understand the type of environment that spider mites enjoy, you will be better equipped to alter the conditions and control infestations. You can employ biological control methods, chemical pesticides, and Integrated Pest Management (IPM), which is our preferred method as it has the least impact on our natural environment and is far safer to the fish.

A misting system will work wonders as the mites do not enjoy a moist environment and it is likely they will move on. Alternatively, during warm weather, apply a water spray either from a hand held atomiser or garden hose to create less favourable conditions and to deter this minute pest.

Miticides are available, but not recommended for use in an aquaponics system as they may be harmful to the aquatic life.

Biological control methods that have proven to be effective include the purchase of predatory mites. These good bugs are available for purchase all over the world and will eradicate spider mites in no time at all.

Remember to cease using pesticides if you introduce live bugs as it will harm all bugs, both good and bad. Other predators that will happily seek out the spider mites include praying mantids and predatory thrips.

Our preference for IPM techniques include a range of strategies to prevent infestation in the first place and monitor and manage any outbreaks. The first step is to practise hygiene by inspecting all plants before introducing them to the growing environment. You may need a magnifying glass to do a thorough investigation. If pests are seen at this stage, they can be quarantined and treated, keeping the environment free from attack. Do not throw the infected matter onto your compost heap as this is a perfect place for them to stay over winter. Remove infected stock immediately and, preferably, burn it.

It is a lot easier to prevent infestation and nip the problem in the bud. Simply put, a greenhouse scenario is going to allow the life cycle to speed up drastically. In some conditions the life cycle can be as short as three days, whereas others could be as long as a month.

the BIG BYAP experiment continued...

By Joel Malcolm

At the 3 month mark of the trial systems, it's hard to know exactly what's going on. Systems one and two cycled a lot quicker than system three. The third system had slight levels of nitrites showing well after the first two systems had completely cycled and were giving readings of no measurable levels of nitrites.

There have been low levels of ammonia showing up consistently in the weekly test results in all of the systems and this has been a bit of a worry. We couldn't work out why the levels were consistently around 0.25 when the systems were so mature and had cycled long before. Eventually, we hit on the idea of what might be going on. This was summer time for us here in Australia, and water consumption in the systems was pretty high with evaporation and transpiration through the plants, so we were topping the systems up with between 100 and 300 litres of water each week in each system. We are on bore water here and we hadn't tested the water for quite some time and it dawned on me, the bore water might have levels affecting the systems. Sure enough, the bore water had levels of ammonia of about 0.5 and had a pH of around 5.8.

So, although we had seen a fairly rapid drop in pH and a constant level of ammonia in the weekly tests, it wasn't necessarily related directly to the systems and their performance, but rather other external factors that might be affecting the outcomes. Still, at the end of the day, they all have the same water going into them, so they all have the same factors affecting them. However, if one system is using more water than another and having more top-up water added, then it may have its results skewed a little more than the others.

Water consumption

Total water consumptions, so are reasonably similar. Unfortunately, for the first 5 weeks of the systems operating when we took other readings, we weren't recording the amount of top-up water, however, we will run these trials for over 12 months so that we can get a full 12 month water consumption figure on all three systems. To date, the water consumptions have been reasonably similar, only varying by about 300 litres between the systems. Any difference in water consumption at this stage of the trial is possibly more to do with differences in plant growth in the growbeds.

Fish

We are happy with the way things are going so far. The fish are growing well, though this is just by visual reference (we haven't netted any out to weigh them, we'd rather leave them undisturbed and unstressed). As mentioned above, the fish in system one aren't as happy as the other fish and, therefore, not eating as much.

Plant growth

Plant growth in the beds is an area where things have differed quite substantially, with system three outstripping the other systems by quite a lot. This seems a little unusual considering that system three has cycled slower than the other two systems. The growth rates have been pretty good overall, though as mentioned, a little slow in system one, while system three has had some very impressive growth. We've harvested chillies, capsicums, and plenty of herbs, especially thyme, from all the systems.

Feed

System three has also had about 10% more feed than the other two systems. The difference in feed rates has been directly linked to how hungry the fish are. We have been feeding to the fish requirements rather than trying to force a set amount of feed into the fish. With only a 10% difference in feed rates overall, the plant growth rates seem to have been disproportionate. We will be monitoring the plant growth fairly closely to see how things develop over time.

Plant Harvests

Summary

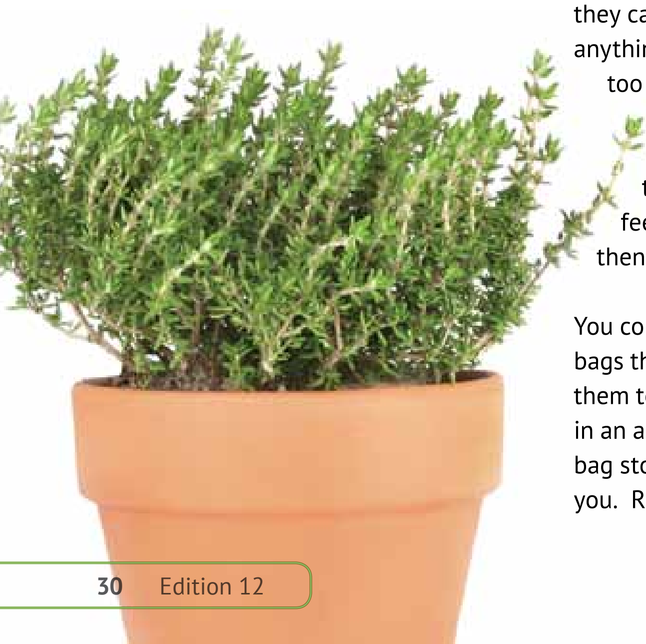
So, far the results have been interesting. With system three surging ahead in plant growth, and system one lagging behind, we really aren't sure exactly why this is so. System number two is sitting right between the two of them, perhaps closer to system three with its plant growth. We expect that over time things will even out over the three different systems, but only time will tell. Harvests have been reasonable so far, herbs are abundant, chillies are coming on very well. In fact, most things are doing very well.

How to dry & store your herbs

By Faye Arcaro

If we could all make use of our own dried and stored herbs, we would definitely be saving ourselves a lot of money at the end of each month. Remember how the older generations used to utilize every available space in their homes? Well, it was a time when preserving, drying, and storing was a common thing to do.

Today, with our hectic lifestyles, we just pop into a store and buy a bottle of flaked garlic, rush home, and sprinkle it onto our food without giving it another thought. There is no time to savour, ponder, or conjure. It is all about money and the lack of time. What a great pity that mankind had to be reduced to a hustle and bustle existence, without being afforded the time to enjoy and appreciate the smaller things in life.



However, the art of drying your own herbs is again taking off in society today. With healthy eating habits being promoted both online and offline every day, we are actually sitting up and taking note. Drying herbs is such a fulfilling pastime that many treat it as a hobby with benefits.

If you are harvesting from your own garden, then harvest the herbs before they flower. Begin to dry your herbs in late summer. Cut them in mid-morning as the dew would have evaporated by then.

First off, dry the leaves while they are on the stems. Bundle them by taking a few twigs at a time and wrap some string or elastic bands around the bottom of the stems. Hang them upside down on hooks or some other device from which they can hang. They should not touch anything, though. Don't let them dry out too long, as they are likely to collect more dust than what you have bargained for. Remember to label them adequately. After a few days, feel the leaves; if they are brittle, then they are ready for consumption.

You could also place the herb in paper bags that have a few holes punched in them to serve as ventilation. If you are in an area that is prone to dust, then the bag storage method would better suit you. Remember to have enough labels handy to mark and paste on each bag.

Some people will dry their herbs on cookie sheets in their ovens, provided the oven settings can maintain a temperature between 80-90 degrees F.

Harvesting

Seeds are harvested by placing a bag under each plant and snipping off the heads. If you are drying roots, then ideally you need a dehydrator which will do the job for a great many herbs at once. You will need to slice your roots or dice them into small sections to get them evenly dried out. Set your dehydrator on air flow only or set it at its lowest setting.

Storage is essential as you could quickly lose the flavour of your herbs if you leave it in the open. Glass is the best method, and if you could get some, dark brown glass is ideal as it protects the herbs from harmful light.

Your storage area should be set aside for this purpose only. For example, do not put your herbs in a cupboard which you know will be opened a few times a day. Your delicate stash should be safely stored so it won't be exposed to heat or light.

Building an IBC system

By Joel Malcolm

Last edition, Joel introduced you to the IBC and its properties and uses. Here is a simple step-by-step guide to building an aquaponic system using an IBC. There are about as many different ways this can be done as there are different types of bread. Everyone seems to have their own preference as to how they build their system. This is how we built ours. It's not necessarily the best way depending on your requirements, but this was a way to build a system very simply, using the IBC as best as we could with a minimum of tools. The only tools you will need are a grinder, a drill, and hacksaw. Thats right, just a grinder, a drill, and hacksaw and you can build your own aquaponic system. You don't need any fancy tools, this is about simplicity.

Tools

Angle grinder with cutting disk & grinding disk
Drill
Ruler
Pipe cutter or hacksaw
Marking pen
Spray Paint

Protective Equipment

Ear muffs
Gloves
Safety glasses

What you'll need to build the IBC system

Parts

Pump
1.5m flexible pipe
barbed threaded elbow
threaded 25mm T piece
4 x 25mm elbows
4.5m of 25mm pipe
20cm of 40mm pipe
40-25mm reducing coupling
50mm x 2" valve socket
30cm piece of 90mm storm pipe
90mm stormwater cap
200L of media
Two 30x50 timber supports
1 x IBC
cable ties

STEP BY STEP

THE BEGINNING

To begin with, you should be sure your IBC has been thoroughly drained and had an initial rinse. Have you checked what was in the IBC beforehand? Have you looked up the contents of the MSDS (Material Safety Data Sheet) to ensure that the previous contents aren't going to cause your fish or yourself any issues? This is extremely important, some IBCs may have had contents which make them unusable. The IBC we are using used to contain clean new, heavy motor oil. Not the nicest of substances, but at least we know that it will be reasonably straight forward to clean and the contents weren't toxic.

One other aspect to this, there are many different IBCs made by different manufacturers and not all of them are the same. Some have wire mesh cages, some a have wooden or plastic pallet base. They are many and varied, however, this IBC we are using is one of the most commonly found IBCs. A fairly standard design, the one we used is made by Schuts, one of the biggest worldwide manufacturers of IBCs.

First step to making your system is to remove the top two bars which hold down the inner liner. These generally require an unusual star shaped driver called a Torx head. Not everyone has these available as part of their standard tool set, however, a flat head screwdriver can fit into it, you just need to have the right size which should be reasonably easy.

WORKING ON THE LINER

Remove the two top bars holding the liner in the frame

Once you have unscrewed the two top supports and removed them, you can now remove the inner liner from the outer frame. It's time to cut the frame to size for the growbed.

For this system, we are going to use the base of the IBC frame as the growbed support, so here we will be cutting the frame off just above the first horizontal support. Be sure to use a thin cut-off disk on your grinder for this. Also, be sure that you have all of your personal protective gear on when using power tools like grinders. Accidents happen when you least expect them.

Be sure to cut these all at the same level, just above the horizontal, as the top section of frame will ultimately become the fish tank surround and the stand which the growbed sits on. Once you have cut off the bottom section of frame, you may want to clean up the edges of the cuts. You can either do this with a file, or you can swap your cutting disk to a grinding disk and take off any sharp bits with your grinder.

Remove the liner from the frame

Now you may want to cut the IBC into the fish tank and the growbed sections. For this, you will need to mark out where your cut will be first. With this system, we will be using the top of the liner as the growbed. We will be making the growbed about an inch taller than the growbed frame. This makes it around 23cm deep. Anywhere between 20 and 30cn will give you a nice growbed which will grow most plants. Our life was made easy by the fact that there is a mark on the IBC liner from the frame, at exactly the point where we want to cut. If you don't have any mark on your IBC, then you can measure up from the base to where you want the top of your growbed. Probably the easiest way to do this is to put the IBC liner top down into the frame, as it will be ultimately set up. Then you can see how high you want your bed to be. This is where we recommend about an inch above the horizontal frame support.

Use a straight edge to mark out your cut off point. Once marked, use your angle grinder to carefully cut the top growbed section off the liner. Be sure to use a thin cutting blade for this.

MAKING THE GROWBED

Now we want to cut the hole in the base of the IBC frame for the growbed drain. Remove the 50mm central plug from the lid of the IBC, place the growbed liner into the frame, now use a pen to mark the cut out hole that is needed in the base. Using the grinder with cutting disk again, cut out a large square that will allow enough space for a 50mm fitting to poke through the hole. You may need to begin by cutting from the top, and then turn the base over to cut from the other side. When you think you have a large enough hole cut in the base, screw your 50mm fitting into the lid, turn the bed upside down, and drop it into the frame to be sure it fits through your new hole.

Cut the hole in the steel base large enough for the drain fittings

CLEAN THE IBC

Once the IBC liner has been cut, you can now give it a good clean easily, because you can access the whole inside surface. Since ours contained oil, we needed to give it a good wash out with a strong detergent and hot water. We ended up giving it two good washes with detergent to remove all the oil residue and after the second rinse, it was nice and clean.

Cleaning the IBC sections is easier once you have cut it open

PLACING THE GROWBED

Now we place what was the upper section of the IBC frame on the ground in the place where we want the system to be finally located. We then used two pieces of wood, 30 x 50 timber from an old timber pallet, to provide supports for the growbed frame. You can use a variety of different timbers for this purpose, depending on what you have locally available in your area. You could just place the growbed onto the top of the metal frame, but by using timbers we are able to push the growbed back a bit further to allow for more access into the fish tank.

Once your timbers are in position, place the growbed on top as you can see in our photographs. Notice that the growbed has been twisted sideways 90 degrees, this also helps provide more access to the fish tank.

So, now your growbed is on top of the fish tank, and next, you will need a standpipe surround. We use 90mm storm water pipe with many 6mm holes drilled in it. This keeps the media away from the standpipe and drain, and allows an access point for you to check the drain to make sure it is free of plant roots. The 90mm pipe section sits nicely in the red cap of the IBC.

Place the growbed frame on top and insert the growbed

Making the standpipe which controls the water level in the growbed

FLOODING THE GROWBED

You can attach a hose to the 50mm fitting in the base of your growbed so that the dirty water is run off into a garden, or alternatively, you can just open the tap in the bottom of your fish tank and let the water run away. Hose down the media in your growbed for about 5-10 minutes, until the water starts to run fairly clear. Once the water is running clear, you can stop washing the clay and fill up your fish tank.

Now we just need to install the pump and pipe work, then the system is done. First, let's look at installing a standpipe. A standpipe like this will allow you to run the system in a couple of ways. You can run it as a constantly flooded system, using the standpipe to set the height of the flooding water in the growbed. Or alternatively, you can use a timer on the pump to make your flood and drain as often as you like. The standpipe is made from a 40-25mm reducing coupling with some 40mm pipe and a couple of 6mm holes drilled near the bottom. The 6mm holes allow the bed to drain if you set it up as flood and drain. They also allow the water to drain out of the bed if you have it set up as a constant flood system and the power goes out.

It's a good idea to keep your standpipe a bit longer to begin with. Once you start pumping, you can cut some off the standpipe and fine-tune the height.

Filling the growbed with media

IRRIGATION & FINISH

We are using a submersible pump and a flexible anti-kink hose to run water up to the growbed. We start by sitting the pump on the ground next to the system. This allows us to measure the length of flexible hose we will need to reach up to the growbed. Be sure to allow a little extra length in the pipe so that you can access it and move it around with ease. I won't go into too much detail about how to attach your pipe to your pump because every pump is different. Here, you will have to find the right fittings for your pump and pipe. Your pump size may vary depending on what you have available locally, or also depending on your long term plans. If you are thinking of expanding your system at some stage, it's probably better to get a slightly larger pump now, rather than having to replace it down the track. The pump we are using in this system is 3000L/h, probably a little overkill, but this will allow some expansion. You want to have at least 1000L/h for a system of this size.

The pipe then comes up to the growbed. On the growbed, we like to irrigate the water around the edge of the bed which allows any solids to be distributed around the beds. So, we have 4 pieces of pipe cut to size to fit around the bed, along with a T piece and barbed fitting that will fit the anti-kink hose. The pipe work around the top edge of the growbed has 6mm holes drilled in the underside of it and is spaced around 150-200mm apart. This means that the water is sent straight down into the media (you don't want water splashing on the surface of the media if you can help it). This will grow algae over the surface of the media.

Pretty much done now. You can run this either as a constantly flooded system, or you can put a timer on the pump and run it as a flood and drain system.

If possible, try to get some water from an established aquaponic system, or perhaps from a friend with an aquarium or a pond. This water will contain the beneficial bacteria to help get your system cycled quickly.

Install the pipe work around the top of the growbed

Measure and cut the flexible anti kink pipe

The Finished IBC

Start planting seedlings into the bed

Glossary

Acidic	Having a pH of less than 7
Aerobic	Requiring, or having abundant air
Aggregate	Course material including crushed rock or gravel
Alkaline	Having a pH above 7
Ammonia	Produced by the fish in their waste and through the gills, can build up becoming toxic if not diluted or converted in the system
Anaerobic	Dead zones caused by lack of oxygen, harbour bacteria and release harmful toxins
Aphid	Soft bodied, sap sucking insects may be white, yellow, black or green
Aquaculture	The cultivation of aquatic animals and plants in a controlled environment
Aquaponics	Symbiotic relationship of plants and fish growing together in a system
Autosiphon	Useful mechanism for controlling flood and drain cycles of a grow bed
Bacillus thuringensis	Naturally occurring micro-organism effective as a treatment against caterpillars. Certified organic and not harmful to beneficial organisms
Bacteria	Naturally occurring microscopic organisms both good and bad
Biological filter	Place that supports the colonisation of nitrifying bacteria eg. growbed
Blue metal	Greyish coloured crushed rock or aggregate, usually granite
Broodstock	Mature fish used for spawning and the production of young
Buffer	Additive which resists changes in pH when small quantities of an acid or alkali are added
BYAP	Backyard Aquaponics
Calcium	Silver/white soft alkaline earth metal. Necessary for plant growth
Calcium carbonate	Found naturally in chalk, limestone, and marble, used to buffer pH
Carnivore	An organism that feeds mainly or exclusively on animal tissue
CHIFT PIST	Constant height in fish tank - pump in sump tank
Chloramine	Combination of ammonia and chlorine usually used as a disinfectant and water treatment
Chlorine	Powerful bleaching, disinfecting agent. Used for producing safe drinking water
Clay	Naturally occurring consisting of fine-grained minerals which hardens when fired or dried
Coir	Natural fibre extracted from coconut husks
Cycled	When a system has established populations of beneficial bacteria
Cycling	The process of establishing bacteria populations in a system
Dechlorinate	To remove chlorine
DWC	Deep water culture: hydroponic method of growing plants suspended in nutrient rich water
Deficiency	A lack or shortage of
Detritus	Waste or rotting matter in the bottom of a fish tank
Dissolved oxygen	A measure of oxygen dissolved in or carried in a given media
DWV	Drain waste vent: type of pipe and fittings used for drain waste and vent plumbing
Ebb and flow	The process of flooding and draining a media-filled growbed
Expanded Clay	Clay pellets fired in a kiln which expands into porous “balls”
FCR	Feed conversion ratio: amount of feed fed to an animal, compared to weight it puts on
Fingerling	Young fish that have developed to about the size of a finger
Flood and drain	Flooding and draining fish water in a media filled grow bed.
Food grade	Components made to a standard for coming into contact with food stuff
Fry	Young or very small fish
Fungicide	Chemical compounds used to kill or inhibit fungal spores or fungi
Gravel	Rock particles
Growbed	Where the plants grow in an aquaponic system
Growing media	Substrate for bacteria habitat and plant root anchoring
Hybrid	The offspring of two animals or plants of different breeds, varieties, species, or genera
Hydroponics	Growing of plants without soil
Hydroton	Type of expanded clay/clay balls with high water storage capacity
IBC	Intermediate bulk container to store and transport liquids
Irrigation	Artificial application of water to land or soils
LECA	Light expanded clay aggregate
Lime	Calcium oxide. Extracted by heating limestone, coral, seashells, or chalk. Used for buffering pH
Limestone	Sedimentary used for buffering pH
NFT	Nutrient film technique where plants are suspended in a small enclosed gutter and thin film of water is passed through the roots to deliver nutrients.
Nitrate	Naturally occurring nitrogen available for plant use

Nitrite	Produced as part of the nitrogen cycle, highly toxic to fish
Nitrogen cycle	Process which nitrogen is converted between various chemical forms
Nitrobacter	Bacteria which oxidises nitrite into nitrate
Nitrosomonas	Bacteria which oxidises ammonia into nitrite
PPM	Parts per million
PPT	Parts per thousand
Purge	Removal of impurities by cleansing
PVC	Polyvinyl chloride- plastic polymer
Salt	Mineral mainly composed of sodium chloride
Species	Biological classification for a group of organisms capable of interbreeding and producing fertile offspring
Standpipe	Standpipes set the maximum water level in a grow bed, and excess water that is pumped into the bed goes straight over the top of the standpipe and down the drain
Standpipe surround	Casing for the standpipe which allows water to flow through pre-drilled holes
Stormwater	Water that is derived during rain events
UV stabilised	Substance/object protected from long-term effects of light and ultra violet exposure

Ammonia Toxicity Chart

Total Ammonia Nitrogen (TAN) - ppm											
Temp (°C)	**pH**										
	6.0	6.4	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4
4	200	67	29	18	11	7.1	4.4	2.8	1.8	1.1	0.68
8	100	50	20	13	8.0	5.1	3.2	2.0	1.3	0.83	0.5
12	100	40	14	9.5	5.9	3.7	2.4	1.5	0.95	.61	0.36
16	67	29	11	6.9	4.4	2.7	1.8	1.1	0.71	0.45	0.27
20	50	20	8.0	5.1	3.2	2.1	1.3	0.83	0.53	0.34	0.21
24	40	15	6.1	3.9	2.4	1.5	0.98	0.63	0.4	0.26	0.16
28	29	12	4.7	2.9	1.8	1.2	0.75	0.48	0.31	0.2	0.12
32	22	8.7	3.5	2.2	1.4	0.89	0.57	0.37	0.24	0.16	0.1

Fruit & Vegetable **Planting Guide**

*For Northern Hemisphere **(NH)** & Southern Hemisphere **(SH)***

Spring

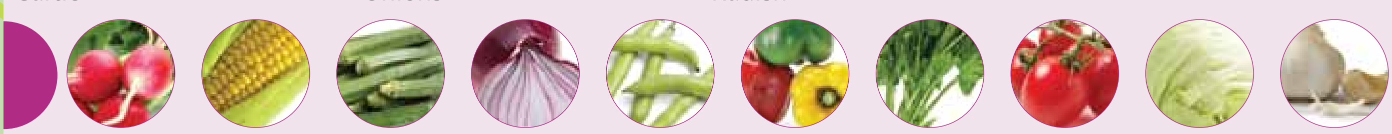
NH: March, April, May | *SH: September, October, November*

Artichoke
Beans
Cantaloupe
Carrots
Collards
Corn
Cucumber
Eggplant
Garlic
Herbs
Kale
Kohlrabi
Leeks
Lettuce
Melons
Mustard Greens
Okra
Onions
Parsley
Parsnips
Peanuts
Potatoes
Pumpkins
Radish
Spinach
Squash
Strawberries
Swiss Chard
Turnips
Tomatoes
Watermelon
Zuccini

Summer

NH: June, July, August | *SH: December, January, February*

Beans
Chard
Corn
Garlic
Herbs
Lettuce
Mustard Greens
Onions
Okra
Peppers/Capsicum
Spinach
Radish
Squash
Tomatoes



Autumn/Fall

NH: September, October, November | *SH: March, April, May*

Beetroot
Bok Choy
Broccoli
Brussels Sprouts
Cabbage
Carrots
Cauliflower
Celery
Endive
Garlic
Kale
Kohlrabi
Lettuce
Mustard
Onions
Parsley
Peas
Radish
Spinach
Sugar Peas
Swiss Chard
Turnips

Winter

NH: December, January, February | *SH: June, July, August*

Asparagus
Beetroot
Broccoli
Brussels Sprouts
Cabbage
Cauliflower
Endive
Horseradish
Kale
Kohlrabi
Lettuce
Onions
Parsley
Parsnips
Peas
Radish
Rhubarb
Shallots
Spinach
Swiss Chard
Turnips

Conversion Table

Metric length		imperial
1 millimetre [mm]		0.03937 in
1 centimetre [cm]	10 mm	0.3937 in
1 metre [m]	100 cm	1.0936 yd
1 kilometre [km]	1000 m	0.6214 mile

Imperial length		metric
1 inch [in]		2.54 cm
1 foot [ft]	12 in	0.3048 m
1 yard [yd]	3 ft	0.9144 m

Metric volume		imperial
1 cu cm [cm3]		0.0610 in3
1 cu decimetre [dm3]	1,000 cm3	0.0353 ft3
1 cu metre [m3]	1,000 dm3	1.3080 yd3
1 litre [l]	1 dm3	1.76 pt
1 hectolitre [hl]	100 l	21.997 gal

Imperial volume		metric
1 cu inch [in3]		16.387 cm3
1 cu foot [ft3]	1,728 in3	0.0283 m3
1 fluid ounce [fl oz]		28.413 ml
1 pint [pt]	20 fl oz	0.5683 l
1 gallon [gal]	8 pt	4.5461 l

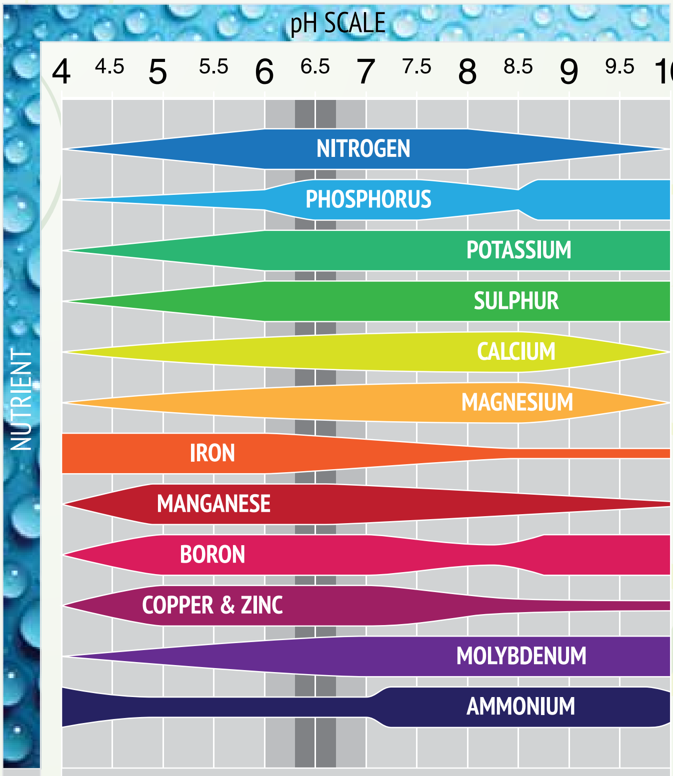
USA volume		metric
fluid ounce	1.0408 UK fl oz	29.574 ml
1 pint (16 fl oz)	0.8327 UK pt	0.4731 l
1 gallon	0.8327 UK gal	3.7854 l

Metric Mass		imperial
1 milligram [mg]		0.0154 grain
1 gram [g]	1,000 mg	0.0353 oz
1 kilogram [kg]	1,000 g	2.2046 lb
1 tonne [t]	1,000 kg	0.9842 ton

Imperial Mass		metric
ounce [oz]	437.5 grain	28.35 g
1 pound [lb]	16 oz	0.4536 kg
1 stone	14 lb	6.3503 kg
1 hundredweight [cwt]	112 lb	50.802 kg
1 long ton (UK)	20 cwt	1.016 t

Temperature Celcius		Fahrenheit
0 °C		32 °F
5 °C		41 °F
10 °C		50 °F
15 °C		59 °F
20 °C		68 °F
25 °C		77 °F

pH v Nutrient Scale



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Work is well under way on the **thirteenth edition** of the magazine. We will continue to showcase systems belonging to members of the online discussion forum, there will be information on vegetables and plants well-suited to aquaponics systems, plus lots of useful hints and tips.

It's promising to be an exciting issue, packed full of information.

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